Lewis-Burke Associates LLC

Summary and Analysis of Programs of Interest to the Applied Mathematics and Computational Science Communities in the President's FY 2017 Budget Request

Prepared by Lewis-Burke Associates LLC
February 19, 2016

Table of Contents

Introduction

President Obama released the last budget request of his Administration on February 9th. The budget proposal nominally adheres to the top defense and non-defense discretionary spending levels agreed to by Congress in the fall of last year. However, the White House is relying on mandatory spending, which requires Congress to pass legislation to make these expenditures outside of the yearly appropriations process, to fund additional priorities in a flat budget environment. While the new initiatives and policy priorities provide the research and education communities a rallying point for advocacy, this mandatory funding will almost certainly not be embraced, since Congress would have to enact new taxes and designate the revenue specifically for the purposes of funding these programs.

Highlights of the budget request for the SIAM community include:

- National Science Foundation (NSF) – $7.964 billion in FY 2017 (6.7 percent above the FY 2016 appropriated funding level), with an increase of 6.5 percent for the Division of Mathematical Sciences and 6.3 percent for the Division of Advanced Cyberinfrastructure;
- Department of Energy's Office of Science – $5.57 billion in FY 2017 (4.2 percent above the FY 2016 appropriated funding level), with Advanced Scientific Computing Research increasing 6.8 percent;
- Department of Defense Basic Research – $2.10 billion in FY 2017 (9.0 percent below the FY 2016 appropriated funding level), with DARPA basic research increasing by 8.8 percent; and
- National Institutes of Health – $33.1 billion in FY 2017 (2.6 percent over the FY 2016 appropriated funding level).

As in prior years, the budget request outlines a consistent agenda for research and education organizations, with initiatives focused on advanced manufacturing, neuroscience, Alzheimer's research, basic and applied energy, and advanced computing as well as efforts to increase college access (e.g. year-round Pell Grants), completion, and outcomes. These types of focused thrusts would continue to receive the bulk of proposed new investments directed toward federal research and education agencies. At the same time, the request continues prior proposals to identify savings and increased efficiencies such as cuts to indirect medical education in favor of new policies associated with healthcare delivery and cuts in defense basic research accounts in favor of more applied or translational initiatives.

To further his legacy on research, education, and other funding priorities and potentially influence the next White House Administration and Congress, the President has laid out ambitious multi-year agendas for his top priorities, despite this being his last year in the White House. While the Congress may disagree with many of his proposed savings, mandatory funding streams, and new initiatives, several of the recommendations are bipartisan priorities that will receive some traction from both parties. In particular, new investments in exascale computing, a focused cancer initiative (as first discussed during the President's State of the Union), cybersecurity, and expansion of science, technology, engineering, and mathematics (STEM) education are all expected to receive congressional support. Beyond the budget proposal itself, the White House also recently released a Federal Cybersecurity Research and Development Strategic Plan, a Cybersecurity National Action Plan, and a $1.8 billion emergency funding plan to combat the Zika virus, all of which are expected to be met with strong congressional support and interest.

The submission of the President's budget request officially kicks off what is expected to be a fairly aggressive congressional cycle to consider annual appropriations bills. While the advocacy communities will advance their priorities, with only $3 billion in additional spending from FY 2016 to FY 2017 across the entire federal discretionary budget, FY 2016 enacted funding levels provide a more realistic starting point for FY 2017 budget discussions.

National Science Foundation

The President's FY 2017 budget request includes $7.964 billion for the National Science Foundation (NSF), which is an increase of $500.5 million or 6.7 percent over the FY 2016 enacted level. Of this increase, $400 million would be new mandatory funding. For discretionary funding, NSF would be funded at $7.564 billion, $100.5 million or 1.3 percent above FY 2016.

- Fundamental research as well as strategic investments in Administration priority areas such as clean energy, neuroscience, resilience, sustainability, and broadening participation remain priorities for NSF.
- New mandatory funding of $400 million is proposed to strengthen core research support across Directorates with a focus on early career investigators. However, this funding stream is unlikely to be supported in Congress.
- While Congress remains supportive of the basic research funded by NSF, continued disagreements over whether to fund NSF at the individual directorate level complicate efforts to raise NSF's budget overall. Additionally, concerns remain over issues of transparency and oversight.

Research and Related Accounts

The FY 2017 request would fund Research and Related Accounts (R&RA) at $6.425 billion, an increase of $391.8 million or 6.5 percent over the FY 2016 level. Of this amount, $346 million would be supported by new mandatory spending while the remaining $6.079 billion would come from discretionary funds, increasing R&RA by $45.8 million or 0.8 percent over the FY 2016 level.

Under the proposal, all six Directorates within R&RA would receive significant increases over the FY 2016 level, with the largest increase going to the Directorate for Engineering (ENG, up 9.4 percent). Biological Sciences (BIO, up 6.2 percent); Computational and Information Science and Engineering (CISE, up 6.3 percent); Geosciences (GEO, up 6.1 percent); Mathematical and Physical Sciences (MPS, up 6.5 percent); and Social, Behavioral, and Economic Sciences (SBE, up 6.1 percent) would receive increases largely on par with one another. Under discretionary spending alone, all directorates would be close to flat with increases ranging from 0.1 percent for GEO and SBE to 0.4 percent for MPS. One exception is ENG, which would see an increase of 3.3 percent from discretionary spending alone.

Division of Mathematical Science

The FY 2017 proposal would provide $249.2 million for the Division of Mathematical Sciences (DMS) within MPS, an increase of $15.1 million or 6.5 percent over the FY 2016 level. Within this amount, $14.1 million would come from new mandatory spending. The request would result in the highest funding level for DMS in the division's recent history, surpassing the FY 2012 high-water mark by $11.5 million or 4.8 percent. The discretionary funds alone would provide an increase of $1 million or 0.4 percent over the FY 2016 level, but still 1.1 percent below the FY 2012 level.

All of the divisions within MPS would receive increases similar to that which would be provided to DMS. The Division of Physics (PHY) would receive an increase of 6.6 percent over FY 2016; both the Division of Astronomical Sciences (AST) and the Division of Chemistry (CHE) would be increased by 6.4 percent; and the Division of Materials Research (DMR) would be increased by 6.3 percent. The Office of

Multidisciplinary Activities (OMA) would receive the highest increase, up 7.3 percent over FY 2016. Consistent with the DMS budget request, these increases would be almost entirely contingent upon the authorization of new mandatory spending.

NSF notes that approximately 52 percent of DMS's FY 2017 request would be available for new research grants. The budget request notes that DMS continues to fund core research programs across a number of areas, including algebra and number theory, analysis, applied mathematics, computational mathematics, geometrical analysis and topology, mathematical biology, and various statistical areas. DMS would continue to invest in NSF-wide initiatives. The vast majority of the proposed increase for DMS would support core research and interdisciplinary research programs while education funding (Mathematical Sciences Postdoctroal Research Fellowships and Research Experiences for Undergraduates) would be held flat and Mathematical Sciences Research Institute would be decreased by 7.4 percent to $25.2 million.

Details of DMS's activities proposed FY 2016 include:

- *Participation in the NSF-wide CEMMSS initiative*: DMS would provide $5.6 million, up $3.5 million over FY 2016, for investments in new mathematical modeling, computational simulation, and numerical algorithm capabilities to advance fundamental research in materials science and advanced manufacturing.
- *Participation in the Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21) initiative*: DMS would contribute $4.9 million, $1.6 million over the FY 2016 level, toward investments in next generation mathematical and statistical theories and tools in order to address new challenges presented by the expanding role and capabilities of computational modeling and simulation, and digital and observational data.
- *Optics and Photonics*: DMS would contribute $3.5 million toward the optics and photonics emphasis, $2 million above the FY 2016 level, to accelerate research in optics and photonics, which have applications in multiple disciplines. DMS would lead and coordinate MPS's participation in this NSF-wide activity.
- *Participation in BioMaPS and Understanding the Brain (UtB)*: DMS would contribute $3.26 million, equal to the FY 2016 level, for innovative research at the interface of mathematical and biological sciences. Contributions to UtB would increase $425,000 to $5.3 million for cross-disciplinary research focused on the understanding the full complexity of the brain, in action and in context.
- *Participation in NSF-wide Innovations at the Nexus of Food, Energy, and Water (INFEWS) and Risk and Resilience initiatives*: DMS would contribute $400,000 and $500,000 to the INFEWS and Risk and Resilience initiatives, respectively, level with the amount it provided in FY 2016. These investments would contribute to the development of tools for increased infrastructure resilience and natural and anthropomorphic disaster mitigation.
- *Secure and Trustworthy Cyberspace (SaTC)*: DMS would provide $2 million toward SaTC, equal to the amount provided in FY 2016.

Division of Advanced Cyberinfrastructure

The Division of Advanced Cyberinfrastructure (ACI) would receive $236.3 million in FY 2017, an increase of $14 million or 6.3 percent over the FY 2016 level. Of this amount, $13.4 million would be supported by new mandatory spending, with the remaining $222.9 million coming from discretionary funds. The

discretionary funds alone would result in a small increase of $620,000 or 0.3 percent over the FY 2016 level.

Research activities within ACI would receive the entire $14 million increase, rising to $107.3 million in FY 2017. ACI will still continue to provide leadership investments in the sun-setting NSF-wide CIF21 initiative, though it will begin transitioning funds to the new National Strategic Computing Initiative (NSCI) and the Data for Scientific Discovery and Action (D4SDA) investment. ACI will also continue to provide computational capacity to enable researchers working in other NSF priority areas such as Risk and Resilience and INFEWS. NSF notes that 36 percent of ACI's portfolio would be available for new grants, while 64 percent would be reserved for ongoing grants.

Details for ACI's activities proposed for FY 2016 include:

- *Participation in CIF21, NSCI, and D4SDA*: ACI's investment in CIF21 will be reduced by $12.7 million in FY 2017 for a total of $50 million as these activities are transitioned to NSCI and D4SDA. ACI will contribute $7.7 million to NSCI and $4.7 million towards D4SDA. Together with MPS, ACI will co-lead the NSF-wide NSCI facilitating the development of resilient, reusable, and durable scientific software architectures to advance discovery through scientific computation. For D4SDA, ACI will invest in data science infrastructure for research communities and well as community governance of data related to NSF's *Public Access Plan*.
- *Participation in Risk and Resilience*: ACI will contribute $2.5 million towards the NSF-wide Risk and Resilience initiative to enable the development of interoperable research cyberinfrastructure.
- *Participation in SaTC*: ACI will provide $3 million for SaTC while leading the Transition to Practice (TTP) Option, which focuses on the adoption of advances in security.
- *Participation in INFEWS*: As part of its $5 million investment in Clean Energy Technology, ACI will contribute $500,000 towards INFEWS to develop robust and resilient multidisciplinary research software.

New and Signature Initiatives

The President's budget request for NSF for FY 2017 continues to support cross-disciplinary research through NSF-wide activities and initiatives. The new and signature initiatives outlined below build on Administration priorities, linking fundamental research to societal needs.

Clean Energy
The FY 2017 budget request includes $512 million, a 37.9 percent increase above FY 2016 levels, to support fundamental research and education on clean energy technologies including solar, wind, wave, and geothermal as well as alternative fuels (chemical and biofuels). Under the clean energy technology umbrella, NSF also supports research into the collection, conversion, storage, and distribution of energy sources. This investment would be part of the Administration's proposed Mission Innovation Initiative.

Innovations at the Nexus of Food, Energy, and Water Systems (INFEWS)
The INFEWS initiative would be supported at $62 million for FY 2017, an increase of $13.5 million or 28 percent above FY 2016. INFEWS is an NSF-wide interdisciplinary initiative that aims to understand, design, and model the interconnected food, energy, and water (FEW) systems. For FY 2017, NSF will continue to support activities in INFEWS with a focus on how FEW systems are embedded in societal

contexts; innovations to protect FEW resources; systems to facilitate FEW systems distribution, generation, and consumption; cyberinfrastructure tools for modeling and analyzing FEW systems; and education and training. The Directorate for Biological Sciences (BIO) plans to release a new solicitation focused on phytobiomes and plant ecosystems under the INFEWS umbrella. NSF also expects to continue to emphasize FEW themes in NSF-wide programs, such as the Experimental Program to Stimulate Competitive Research (EPSCoR), Research Experiences for Undergraduates (REU), and programs related to sustainability and data science.

Understanding the Brain (UtB)

The Understanding the Brain (UtB) initiative includes NSF-supported cognitive science and neuroscience research as well as activities specifically focused on the Administration's Brain Research through Advancing Innovation and Neurotechnologies (BRAIN) initiative. UtB would be supported at $141.6 million in FY 2017, down $5.3 million or 3.6 percent, following a major increase of $37.5 million from FY 2015 to FY 2016. Within the total proposed for UtB, $74 million would support the BRAIN Initiative. Priority areas for UtB continue to include "develop[ing] innovative technologies, tools, experimental approaches, theories, and models to integrate neuroscience information across scales and disciplines; identify[ing] the fundamental relationships among neural activity, cognition, and behavior; transform[ing] our understanding of how the brain responds and adapts to changing environments and recovers from lost functionality; and train[ing] a new generation of scientists, engineers, and educators for a transdisciplinary, globally competitive workforce in neuroscience and neuroengineering."[1]

Risk and Resilience

The Risk and Resilience initiative would be supported at $43 million in FY 2017, which is $2 million or 4.9 percent above FY 2016. The program aims to improve predictability and risk assessment and increase resilience to extreme events to ensure minimal impact on quality of life, society, and the economy. For FY 2017, NSF plans to continue the Critical Resilient Interdependent Infrastructure Systems and Processes (CRISP) program, led by the Directorate for Engineering (ENG), and the Prediction of and Resilience against Extreme Events program (PREEVENTS), led by the Directorate for Geosciences (GEO).

Inclusion across the Nation of Communities of Learners that have been Underrepresented for Diversity in Engineering and Science (NSF INCLUDES)

NSF INCLUDES would be supported at $16 million in FY 2017, an increase of 3.2 percent or $500,000 over FY 2016. NSF INCLUDES is an initiative that began in FY 2016 and is planned to continue through FY 2020 to support NSF-wide activities as well as domain specific efforts to increase the participation of underrepresented groups in science, technology, engineering, and mathematics (STEM) fields. NSF plans to issue a solicitation in late FY 2016 to create the NSF INCLUDES National Network, including a call for up to five broadening participation Alliances and one Backbone Organization that will ensure collaboration and organize the network. Discipline specific efforts are also expected through Dear Colleague letters and changes to program solicitations for existing broadening participation activities.

Additional Priorities

The FY 2017 budget request also includes the following priorities and highlights:

[1] http://www.nsf.gov/about/budget/fy2017/pdf/42_fy2017.pdf, FY 2017 Budget Request to Congress, National Science Foundation, 2016 (pg. NSF-Wide Priorities-42)

- **Rules of Life:** An increase of $13 million would support activities related to a new emphasis in BIO with a focus on genotype to phenotype challenge, plant and microbial sciences, microbiome, synthetic biology, and the origin of life.
- **Computer Science for All (CS for All):** A total of $20 million would build on current investments to ensure access to computer science classes in K-12 schools. Investments would support development of instructional materials, professional development models, and preservice preparation approaches for computer science teachers as well as research on effective approaches for teaching and learning computer science.
- **Smart and Connected Communities:** An increase of $13 million proposed for the Directorate for Computer and Information Science and Engineering (CISE) to support a network of regional hubs to research networking; sensors; and data management, analysis, and decision making. This will be an NSF-wide activity to include community building efforts, to improve quality of life, health, well-being, and learning in smart and connected communities.

Proposed Reductions and Terminations

Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21)
The budget request proposes $100 million to support the CIF21 initiative, 24.4 percent below FY 2016. CIF21, which is sun-setting at the end of FY 2017, is intended to provide the advanced cyberinfrastructure and new computational capabilities that the NSF community needs to accelerate scientific discovery and innovation. Many CIF21 investments will transition to the new multi-agency NSCI and the new NSF D4SDA investment area. NSCI is proposed for $33 million in FY 2017. Support for Computational and Data Enabled Science and Engineering (CDSE) will also continue beyond the end of CIF21.

Science, Engineering, and Education for Sustainability (SEES)
The budget would support the NSF-wide SEES initiative at $52 million for FY 2017, 29.8 percent below the FY 2016 level. This continued reduction of funding for SEES is consistent with original plans to complete the program by FY 2017. Investments in FY 2017 will continue support for a few SEES programs, including Dimensions of Biodiversity (DoB); Decadal and Regional Climate Prediction Using Earth System Models (EaSM); Sustainability Research Networks (SRN); Coastal SEES; and Sustainable Chemistry, Engineering, and Materials (SusChEM). SusChEM is expected to become an ongoing program following the sun-setting of SEES. Additionally, activities related to programs with broad community interest are planned to be supported beyond FY 2017 through core programs, including Arctic SEES, Coastal SEES, DoB, EaSM, Ocean Acidification (OA), and Dynamics of Coupled Natural and Human Systems (CNH).

Additional Reductions
The FY 2017 budget request also includes the following reductions and terminations:

- **Enhancing Access to the Radio Spectrum (EARS):** would experience a $16 million decrease as NSF plans to terminate investment in this cross-cutting program. Support would continue for ongoing research in wireless communication, spectrum sharing, mobile computing, and wireless and spectrum testbed development.
- **Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE):** down $25 million decrease as NSF plans to end dedicated funding for this program that enabled a special internal review mechanism for potentially transformative interdisciplinary proposals.

Individual Directorates would continue to support INSPIRE-like research through core and cross-cutting programs. NSF plans to develop a new funding mechanism using many of the INSPIRE principles.

Ongoing Areas of Interest

Secure and Trustworthy Cyberspace (SaTC)
The SaTC program would be supported at $150 million in FY 2017, an increase of 15.4 percent above FY 2016. SaTC aims to lay the foundations of cybersecurity research for years to come and aligns with the four thrusts outlined in the *Trustworthy Cyberspace: Strategic Plan for the Federal Cybersecurity Research and Development Program.*[2] NSF plans to add a new Transition to Education mechanism in FY 2017 to support transition of research results to relevant curricula. In addition to continuing current thrusts, SATC would also focus on secure advanced manufacturing, the security of cyber-physical systems and the internet of things, and transitioning research results. NSF plans to support at least one experimental testbed for cybersecurity. In addition, the CyberCorps Scholarship for Service (SFS) program would increase 40 percent to $70 million, with $25 million used to lay the groundwork for SFS alumni to help the government rapidly respond to cybersecurity challenges.

Cyber-enabled Materials, Manufacturing, and Smart Systems (CEMMSS)
The CEMMS program supports research into materials, advanced manufacturing, robotics, and cyber-physical systems, and contributes to interagency priorities including the Materials Genome Initiative (MGI), the Advanced Manufacturing Partnership (AMP), and the National Robotics Initiative (NRI). In FY 2017, CEMMS would be funded at $257 million, an increase of 0.3 percent over FY 2016 levels. In FY 2017, NSF intends to continue existing programs under the CEMMS umbrella such as Designing Materials to Revolutionize and Engineer our Future (DMREF), Cyber Physical Systems (CPS), the NSF NRI program, and programs related to advanced manufacturing. In addition, NSF plans to begin a new investment in Smart and Autonomous Systems, including workshops on social and behavioral aspects of these systems, competitions and challenges for multidisciplinary efforts, and computational and physical infrastructure needs.

Innovation Corps (I-Corps™)
The Administration continues to support the NSF I-Corps program and would include $30 million in FY 2017, the same level as FY 2016. Funding would support up to 230 I-Corps™ Teams, including up to nine I-Corps™ Nodes and up to 71 active I-Corps™ Sites.

NSF Research Traineeships (NRT)
The NRT program would receive $58 million in its third year of operation, a slight increase of 0.8 percent above FY 2016 levels, although significantly down from the FY 2015 enacted amount of $74 million. NRT aims to support innovative approaches to graduate education in areas of national need and emerging scientific priority. For FY 2017, NSF plans to continue UtB and INFEWS as priority areas, while conducting the emphasis on computation- and data-enabled science and engineering. In addition, the Innovations in Graduate Education (IGE) track would be supported at $7 million.

[2] http://www.whitehouse.gov/sites/default/files/microsites/ostp/fed_cybersecurity_rd_strategic_plan_2011.pdf, Trustworthy Cyberspace: Strategic Plan for the Federal Cybersecurity Research and Development Program, National Science and Technology council

Improving Undergraduate STEM Education (IUSE)
The President's budget request would include $109 million for the Improving Undergraduate STEM Education (IUSE) umbrella, a 3.8 percent increase over FY 2016. IUSE is an NSF-wide effort to improve undergraduate STEM education that includes individual programs in the Directorate for Education and Human Resources (EHR) and individual research Directorates. BIO and CISE both plan to fund new IUSE investments in FY 2017. BIO would fund development of curricula to support biologist education in the context of a data-rich world. CISE would issue a Dear Colleague Letter or solicitation focused on challenges related to growing enrollment and expanding disciplinary backgrounds of students interested in computer science courses, as well as focus on increasing the number of women completing computer science degrees. EHR plans to increase research opportunities for undergraduates within the IUSE:EHR program through support for course-based research and new research courses as well as to increase opportunities for undergraduate research in NSF-funded facilities and national laboratories through the S-STEM program.

Science, Technology, Engineering, and Mathematics (STEM) Education
Beyond graduate and undergraduate education discussed above, NSF continues to prioritize core STEM education research to foster the development of STEM education research communities. EHR Core Research (ECR) would be supported at $107 million in FY 2017, an increase of 58.6 percent. However, much of this increase would be provided through mandatory funding. Under discretionary funding alone, EHR core would be increased 31.0 percent to $91 million.

Source: The full NSF FY 2017 Budget Request can be viewed at:
http://www.nsf.gov/about/budget/fy2017/toc.jsp.

National Science Foundation

(In millions)

	FY 2016 Estimate	FY 2017 Request (discretionary)	FY 2017 Request (discretionary) vs. FY 2016	FY 2017 Request (mandatory)	FY 2017 Request (total)	FY 2017 Request (total) vs. FY 2016
NSF, total	**7,463.49**	**7,564.02**	**100.53 (1.3%)**	**400.00**	**7,964.02**	**500.53 (6.7%)**
Research and Related Activities	**6,033.65**	**6,079.43**	**45.78 (0.8%)**	**346.01**	**6,425.44**	**391.80 (6.5%)**
Biological Sciences	744.17	745.73	1.56 (0.2%)	44.79	790.52	46.35 (6.2%)
Computer and Information Science and Engineering	935.82	938.43	2.61 (0.3%)	56.37	994.80	58.98 (6.3%)
Division of Advanced Cyberinfrastructure	222.30	222.92	0.62 (0.3%)	13.39	236.31	14.01 (6.3%)
Engineering	916.19	946.41	30.22 (3.3%)	56.32	1,002.73	86.54 (9.5%)
Geosciences	1,318.54	1,319.56	1.02 (0.1%)	79.27	1,398.83	80.29 (6.1%)
Mathematical and Physical Sciences	1,349.15	1,355.06	5.91 (0.4%)	81.39	1,436.45	87.30 (6.5%)
Division of Mathematical Sciences	234.05	235.05	1.00 (0.4%)	14.12	249.17	15.12 (6.5%)
Social, Behavioral, and Economic Sciences	272.2	272.41	0.21 (0.1%)	16.36	288.77	12.58 (4.6%)

International Science and Engineering	49.10	49.10	--	2.95	52.05	2.95 (6.0%)
Integrative Activities	447.06	451.30	4.24 (0.9%)	8.56	459.86	12.80 (2.9%)
US Arctic Research Commission	1.43	1.43	--	0	1.43	--
Education and Human Resources	**880.00**	**898.87**	**18.87 (2.1%)**	**53.99**	**952.86**	**72.86 (8.3%)**
Major Research Equipment and Facilities Construction	**200.31**	**193.12**	**-7.19 (3.6%)**	0	**193.12**	**-7.19 (3.6%)**
Agency Operation and Award Management	**330.00**	**373.02**	**43.02 (13.0%)**	0	**373.02**	**43.02 (13.0%)**
National Science Board	**4.37**	**4.38**	**0.01 (0.2%)**	0	**4.38**	**0.01 (0.2%)**
Office of Inspector General	**15.16**	**15.20**	**0.04 (0.3%)**	0	**15.20**	**0.04 (0.3%)**

Department of Energy

The President's FY 2017 budget request proposes $30.2 billion for the Department of Energy (DOE), which is an increase of 2.2 percent over the FY 2016 enacted level. In addition to the $30.2 billion in discretionary spending, the DOE budget request includes $2.3 billion in new mandatory spending proposals.

- The President's budget request would make DOE the lead federal agency supporting "Mission Innovation," an initiative launched in November 2015 by the United States and 19 other countries to double federal funding for clean energy research and development over the next five years with the goal of reducing the cost and accelerating the adoption of new, clean energy technologies.
- The President's budget request proposes the largest funding increases for applied energy programs in renewable energy, energy efficiency, and grid modernization, as well as use-inspired basic research and Advanced Research Projects Agency-Energy (ARPA-E) projects to accelerate the commercialization of new technologies.
- Despite the Obama Administration's "all of the above" energy strategy, the President's budget request reduces funding for fossil and nuclear energy research and development activities, which will meet congressional resistance.
- DOE proposes a number of new initiatives, including a crosscutting research and development effort on advanced materials in extreme environments, a new Energy Innovation Hub to develop low-energy and low-cost desalination approaches, and two new Clean Energy Manufacturing Innovation Institutes with one focused on reducing the cost of manufacturing metals for grid applications.
- DOE is likely to see some increase in funding in FY 2017 given bipartisan support for federal investments in basic research, making the grid more resilient against blackouts and cyber attacks, and efforts to create U.S. jobs from new technology innovations.

Office of Science

The President requests $5.7 billion for the DOE Office of Science, a proposed increase of 4.2 percent. Of the six major Office of Science programs, all would receive funding increases except fusion energy sciences.

Advanced Scientific Computing Research

The budget request would provide Advanced Scientific Computing Research (ASCR) with $663.2 million in FY 2017, an increase of $42.2 million or 6.8 percent above the FY 2016 level. With the exception of Biological and Environmental Research (BER), which would receive an increase of 8.7 percent over the FY 2016 level, ASCR fares best among the major programs within the Office of Science. FY 2017 budgets for other program offices range from a 4.7 percent increase for Basic Energy Sciences (BES) to a 9.1 percent decrease for Fusion Energy Sciences (FES). High Energy Physics and Nuclear Physics would receive increases of 2.9 percent and 3 percent, respectively.

The budget request would reorganize funding to create a new line for the Office of Science Exascale Computing Project (SC-ECP) at $154 million. Previously exascale was captured as a crosscutting initiative

rather than its own budget item. Due to this change, funding has shifted dramatically from Applied Mathematics, Computer Science, Computational Partnerships, and Research and Evaluation Prototypes to this new area, but the budget request mainly proposes a continuation of these activities under the new exascale line rather than a shift in approach. The new ECP would mostly be flat funded relative to the exascale activities that were previously supported under Applied Math, Computer Science, Computational Partnerships, and Research and Evaluation Prototypes. However, funding for the activities previously in the Prototypes account would be reduced by $3.6 million. Funding under ECP for FY 2017 would support co-design activities, the development of an exascale software stack, new programming models for ease of use, research on parallelism and energy efficiency and reliability, and new vendor partnerships intended to facilitate the development of scalable prototypes. SC-ECP is proposed to run for 10 years, and would constitute the Office of Science's contribution to the **National Strategic Computing Initiative (NSCI)**, which aims to position the nation to meet critical national security needs, fully leverage computing technology for economic competitiveness and scientific discovery, and position the U.S. for sustained technical leadership.

The **Mathematical, Computational, and Computer Sciences Research** activity within ASCR would see a steep reduction of $28.3 million or 15.8 percent from the FY 2016 enacted level. However, when the research funding moved to the Exascale Computing Project is included, Research would grow by $17.8 million or 9.9 percent. Within this amount, Applied Mathematics would see $10 million shifted to SC-ECP but would otherwise be flat with FY 2016. Computer Science would see $20.1 million moved to SC-ECP, but would ultimately only be reduced by $17.6 million as new funding would support efforts related to the impact of "Beyond Moore's Law" technologies. Computational Partnerships would be reduced by $2.3 million with $16 million in co-design efforts moving to SC-ECP. Support for Next Generation Networking for Science would remain flat at $19 million in FY 2017.

Activities within Applied Mathematics would continue to support ASCR's focus on developing new algorithmic techniques and strategies for understanding underlying trends within massive data sets, including uncertainty quantification, algorithmic resilience, and strategies for reducing global communications. Including funding moved to support exascale, Computational Partnerships activities would grow by $13.7 million or 28.5 percent. Increased funding would support plans to recompete and expand the SciDAC Institutes and establish new collaborations with BES, BER, and FES on clean energy. New funding would also be directed towards partnerships with BES and BER to develop new capabilities for the BRAIN initiative, seismic simulation research with the National Nuclear Security Administration (NNSA), and a new Office of Science-wide initiative aimed at exploring technologies for moving current computing capabilities beyond Moore's Law.

The **High Performance Computing and Network Facilities** activity would also see dramatic funding shifts as $107.9 million would be shifted to SC-ECP. Overall the Facilities activity would be decreased by $83.5 million or 18.9 percent. However, if the SC-ECP funding related to facilities efforts is included, Facilities would grow by $24.4 million or 5.5 percent. High Performance Production Computing and Leadership Computing Facilities would increase by 7.1 and 3.1 percent respectively in support of operations needs and preparations for planned upgrades at Berkeley, Argonne, and Oak Ridge National Laboratories. Research and Evaluation Prototypes would experience a dramatic reduction with the move of the vast majority of its funding to SC-ECP. However, the remaining activities would see a small increase of $4 million to support a new effort in cybersecurity and a testbed for "Beyond Moore's Law" research. The

Computational Sciences Graduate Fellowship (CSGF) program would be flat funded at $10 million within Research and Evaluation Prototypes.

Other DOE Programs of Interest

Within BES, the budget proposal would maintain the FY 2016 enacted funding level of $12 million for Computational Materials Sciences to support existing awards. The budget would also provide $13.6 million for a new Computational Chemical Sciences program aimed at developing new open-source modular software tools that are optimized for the arrival of exascale computing. This program would also leverage the capabilities of the Leadership Computing Facilities to develop new quantum chemical codes to model, simulate, and solve complex problems in chemistry.

The Office of Science would also assist the National Institutes of Health with its mission goals, including $9 million for high performance computing applications for biomedical research. Additional funding would support development of tools and technologies to support research on the brain ($2.7 million); $9 million for high performance computing applications for biomedical research; and $4 million to develop accelerators, including advanced proton and ion beams, to help treat cancer.

The budget request proposes $350 million to fund the Advanced Research Projects Agency-Energy (ARPA-E), which would represent an increase of 20 percent. ARPA-E anticipates announcing seven to eight new technology programs, including new information and computing technologies for manufacturing and building efficiency applications.

The Administration continues to define crosscutting activities within DOE to better integrate its mission areas. The FY 2017 budget request includes seven cross-cutting initiatives. Six were already identified in the FY 2016 budget request and one new one has been proposed for advanced materials for energy innovation. A total of $1.5 billion in the budget request, funded through the basic research and applied energy programs, is associated with these crosscutting programs:

- Energy-Water Nexus: $96 million
- Exascale Computing: $285 million
- Grid Modernization: $379 million
- Subsurface Technology and Engineering: $258 million
- Supercritical CO2: $36 million
- Cybersecurity: $333 million
- Advanced Materials for Energy Innovation: $113 million

Source: DOE's FY 2017 budget request can be viewed at http://energy.gov/cfo/downloads/fy-2017-budget-justification.

Department of Energy

(In thousands)

	FY 2016 Enacted	FY 2017 Request	Request vs. FY 2016
DOE, total	**29,602,691**	**30,239,955***	**637,264 (2.2%)**
Science	**5,347,000**	**5,572,069***	**225,069 (4.2%)**

Advanced Scientific Computing Research	621,000	663,180	42,180 (6.8%)
Mathematical, Computational, and Computer Sciences Research	179,176	150,854	-28,322 (15.8%)
Applied Mathematics	49,229	39,229	-10,000 (20.3%)
Computer Science	56,848	39,296	-17,552 (30.9%)
Computational Partnerships	47,918	45,596	-2,322 (4.9%)
Next Generation Networking for Science	19,000	19,000	--
High Performance Computing and Network Facilities	441,824	358,326	-83,498 (18.9%)
Exascale Computing	0	154,000	154,000 (100.0%)
Basic Energy Sciences	1,849,000	1,936,730	87,730 (4.7%)
Biological and Environmental Research	609,000	661,920	52,920 (8.7%)
Fusion Energy Sciences	438,000	398,178	-39,822 (9.1%)
High Energy Physics	795,000	817,997	22,997 (2.9%)
Nuclear Physics	617,100	635,658	18,558 (3.0%)
Workforce Development for Teachers and Scientists	19,500	20,925	1,425 (2.3%)
Science Laboratories Infrastructure	113,600	130,000	16,400 (14.4%)
ARPA-E	**291,000**	**350,000***	**59,000 (20.3%)**
EERE	**2,069,194**	**2,898,400**	**829,206 (40.1%)**
Electricity Delivery and Energy Reliability	**206,000**	**262,300**	**56,300 (27.3%)**
Nuclear Energy	**986,161**	**993,896**	**7,735 (0.8%)**
Fossil Energy R&D	**632,000**	**600,000**	**-32,000 (5.1%)**
National Nuclear Security Administration	**12,526,512**	**12,884,000**	**357,488 (2.9%)**

Weapons Activities	8.846,948	9,243,947	396,999 (4.5%)
Defense Nuclear Non-proliferation	1,940,302	1,807,916	-132,386 (6.8%)

*This chart does not include $2.259 billion in requested mandatory spending, which would be comprised of the following: $1.335 billion for the President's proposed Clean Transportation Plan; $674 million for the Uranium Enrichment Decontamination and Decomposition (UED&D) Fund; $150 million in additional funding for ARPA-E; and $100 million for university grants within the Office of Science.

Department of Defense

The President's FY 2017 budget request would provide $71.4 billion for Research, Development, Test, and Evaluation (RDT&E) programs at the Department of Defense (DOD), including $12.5 billion for Science and Technology (S&T) accounts. Compared to the FY 2016 enacted levels, these amounts would represent an increase of 4.3 percent for RDT&E and a 3.8 percent decrease for S&T.

- The *Bipartisan Budget Act of 2015* set the overall FY 2017 base budget and Overseas Contingency Operations (OCO) funding levels for DOD. The budget request adheres to these caps, but some in Congress are likely to push for additional OCO funding to address their defense priorities.
- For the third year in a row, the President would reduce basic research funding across the Department. In FY 2017, the budget request would also propose reductions to applied research and the Army's advanced technology development accounts. Advanced Technology and Development has been increased for the Navy and Air Force as well as DOD-wide for advanced component development and prototypes for strategic capabilities.
- Over the past several years, Congress has shown strong support for basic research and science and technology accounts overall. Many Members of Congress appreciate the value of DOD S&T, but there will be tough trade-offs to make between near-term needs for current conflicts and long-term capabilities to address future threats.

New and Signature Initiatives

The President's budget request for FY 2017 would grow the RDT&E account to $71.4 billion as the DOD moves forward with the "third offset" technology development strategy that is part of the **Defense Innovation Initiative** started in the fall of 2014. The Initiative is designed to spur advancements in science and innovation needed to create game-changing defense technologies for the long-term (for example from 2025-2035). Ideas for a portion of the third offset have recently emerged that emphasize the use of robotics and autonomy (including artificial intelligence) to create five warfighting capability foundations which include:

- Autonomous Learning Systems;
- Human-Machine Collaborative Decision Making;
- Assisted Human Operations;
- Advanced Manned-Unmanned System Operations; and
- Network-enable, autonomous weapons hardened to operate in a future cyber/electronic warfare (EW) environment.

President Obama's FY 2017 budget request identifies biotechnology, electronic warfare, cyber/computing, hypersonics, directed energy, and manufacturing among its research priorities for FY 2017. These are all areas where DOD has already invested during the Obama Administration and are highlighted in the request to attract industry participation.

The President's FY 2017 budget request would decrease basic research (6.1) across DOD and applied research (6.2) in areas such as materials research, combat vehicle development, and Army and Navy

aircraft. In contrast applied research areas such as electronic warfare, next generation GPS, intelligence, surveillance and communications would see increases.

With the 49 percent decrease to the defense-wide basic research initiatives account, FY 2016 congressional increases for the **Minerva** program and **National Security Science and Engineering Faculty Fellowship** are in jeopardy, but details about this account have not yet been released. The **Multi-disciplinary University Research Initiative (MURI)** program is also at risk due to the 30 percent decrease proposed in the Navy's University Research Initiatives account. The **Defense Rapid Innovation Fund** was not requested in the FY 2017 budget, but funding is anticipated to be restored by Congress.

Within the individual military branches, funding for basic research would see the smallest decrease within the Air Force after being the only branch with reduced basic research funding in FY 2016. Funding for FY 2017 would fall 5.7 percent from its FY 2016 level to $500.24 million. This is slightly more than the FY 2016 budget request proposed for Air Force basic research. The **Air Force Mathematics, Information, and Life Sciences** account would fall 10.4 percent to $101.2 million, bringing the account back to its FY 2014 level. This amount is similar to proposed funding in the FY 2016 budget request. Among math-oriented programs, Optimization and Control would see a substantial decrease in funding of 8.2 percent erasing the 7.1 percent increase the program received in FY 2016. Notably, the budget request proposes a very large increase for Outreach to the US Science and Technology Workforce (up 61.9 percent to $22 million) to support young investigators as well as minority serving institutions and K-12 STEM activities.

The Office of Naval Research would see the largest drop in basic research funding after substantial gains in FY 2016. Overall, basic research would fall 19.2 percent, taking the Navy all the way back to its FY 2011 funding level. The request is $40 million less than the Administration requested in FY 2016. Even with the very large decrease overall, **Navy Mathematics, Computer, and Information Sciences** would see a smaller decrease of 7.5 percent to $42.2 million. This decrease would be due to less investment in quantum information and magnetic imaging sciences and therefore should not impact the funding available for mathematics research. The Mathematics, Computer, and Information Sciences activity had substantial growth between FY 2015 to FY 2016, but this was due to the transfer of nanoelectronics into the activity rather than any growth in research efforts.

Finally, President Obama continues to propose funding increases for **DARPA**, which would receive an additional $105 million in base funding for a total of $2.97 billion to support high-risk, high-reward research. Additionally, DARPA's basic research program would see a 9 percent increase in contrast to the rest of the DOD basic research portfolio. The **DARPA Defense Research Sciences** basic research account would receive a substantial increase of 8.8 percent, rising to $362.3 million for FY 2017. Applied research in **Information and Communications Technology** would also increase by 3.6 percent. Details of DARPA's budget request were not available at the time of the writing of this report.

The National Defense Education Program would be increased by 28 percent to support STEM education for military families. Details were not yet available at the time of the writing of this report.

Source: The overview of DOD's FY 2017 budget request can be viewed at http://comptroller.defense.gov/Portals/45/Documents/defbudget/fy2017/FY2017_Budget_Request.pdf; detailed budget documents for each of the service branches and defense-wide programs are available on

the DOD comptroller's website at
http://comptroller.defense.gov/Portals/45/Documents/defbudget/fy2017/fy2017_r1.pdf.

Department of Defense*

(In thousands)

	FY 2016 Enacted	FY 2017 Request	Request vs. FY 2016
RDTE, total	**69,737,016**	**71,391,771**	**1,654,755 (2.4%)**
S&T, Total	**12,996,559**	**12,500,756**	**-495,803 (3.8%)**
6.1, Total	2,309,196	2,101,832	-207,364 (9.0%)
6.2, Total	4,996,199	4,815,400	-180,799 (3.6%)
6.3, Total	5,691,164	5,583,524	-107,640 (1.9%)
Army RDTE	7,562,170	7,515,399	-46,771 (0.6%)
Army Basic	469,079	428,943	-40,136 (8.6%)
Army Applied	1,092,885	907,574	-185,311 (17.0%)
Army ATD	1,127,304	930,065	-197,239 (17.5%)
Navy RDTE	18,111,247	17,276,301	-834,946 (4.6%)
Navy Basic	671,875	542,970	-128,905 (19.2%)
Navy Applied	965,872	861,151	-104,721 (10.8%)
Navy ATD	696,226	736,988	40,762 (5.9%)
Air Force RDTE	25,194,457	28,112,251	2,917,794 (11.6%)
Air Force Basic	530,253	500,024	-30,229 (5.7%)
Air Force Applied	1,240,141	1,260,152	20,011 (1.6%)
Air Force ATD	710,377	725,805	15,428 (2.2%)
DW RDTE	18,681,659	18,308,826	-372,833 (2.0%)
DW Basic	637,989	629,895	-8,094 (1.3%)
DW Applied	1,697,301	1,786,523	89,222 (5.3%)
DW ATD	3,157,257	3,190,666	33,409 (1.1%)
Defense Health R&D	2,121,452	822,907	-1,298,545 (61.2%)

*Does not include Overseas Contingency Operations funding (OCO).

National Institutes of Health

The President's FY 2017 budget request includes $33.1 billion for the National Institutes of Health (NIH), which is a $1 billion (3.1 percent) increase over the FY 2016 enacted level.

- Employing a similar tactic used for other agencies, the Administration is proposing that $1.8 billion of the total NIH budget be in new mandatory funding directed to White House priorities, such as the Vice President's Cancer Moonshot Initiative and precision medicine. This leaves $31.3 billion in discretionary funding NIH, which is less than the $32.1 billion provided for NIH in FY 2016. While congressional appropriators are unlikely to accept the use of mandatory funds to prop up the NIH budget, the strong bipartisan support for NIH suggests they will find a way to provide additional discretionary funding for NIH in FY 2017.
- As previewed by the White House in the weeks leading up to the budget release, the NIH budget request includes funding to launch the National Cancer Moonshot, which is designed to be a multi-year initiative to accelerate the fight against cancer. The budget request would provide $680 million in mandatory funding for the National Cancer Institute (NCI) to substantially increase progress in the cancer prevention, treatment, and discovery. The Moonshot Initiative also includes $75 million in mandatory funding for the Food and Drug Administration (FDA) to develop regulatory pathways for new technologies and to facilitate the sharing of important data across government, academia, and industry.
- This final budget request from the Obama Administration continues the trend of carving out significant funding for White House priority initiatives. This approach appears to resonate with Congress, as it has included increased funding for precision medicine, Alzheimer's, and BRAIN in appropriations bills over the last couple years. However, these signature programs come at the expense of general NIH research funding, as illustrated by flat funding for most Institutes and Centers in the FY 2017 budget request.

The **National Institute of General Medical Sciences** (NIGMS) would receive $2.5 billion overall, level with FY 2016 appropriations, while Research Project Grants that support investigator-initiated research would increase by 3.6 percent across the institute. Funding for the division of Biomedical Technology, Bioinformatics, and Computational Biology (BBCB) would stay virtually flat, decreasing by $60,000 from the FY 2016 enacted level.

The **National Cancer Institute (NCI)** would receive $5.9 billion overall (up 13 percent from FY 2016), while Research Project Grants would similarly increase by 13.6 percent. NCI would contribute $70 million to Precision Oncology. Funding for Understanding Mechanisms of Cancer would increase 13.5 percent from the FY 2016 level to $877.5 million.

The **National Institute of Biomedical Imaging and Bioengineering (NIBIB)** would receive $342.5 million overall (level with FY 2016). Research Project Grants would decrease by 3.9 percent, resulting in a reduction of 31 awards compared to FY 2016. Discovery Science and Technology (DST), which includes support for mathematical modeling and simulation, would decrease 2.9 percent to $103.4 million. High priority will be given to new and early-career investigators. Investigator-initiated research grants will also have priority.

NIH Initiatives of Interest

The President's FY 2017 budget request highlights new and continuing NIH initiatives.

Big Data to Knowledge
In FY 2017, NIH would direct $69.1 million to the Big Data to Knowledge (BD2K) program through the Common Fund to facilitate broad use of biomedical big data by supporting the development of big data software, reference datasets, data analysis, and dissemination methods. This would be a $6.2 million (9.8 percent) increase over FY 2016 to make big data software innovations more user-friendly and support innovative approaches using crowdsourcing and interactive digital media, as well as create a comprehensive data commons for NIH data resources.

National Cancer Moonshot
First announced in the President's State of Union address, the Cancer Moonshot (or NIH Cancer Research Initiative, the agency's preferred term) would receive $680 million to engage across the cancer research and oncology community. This would support a range of activities, including developing new techniques to detect cancer earlier, expanding recent successes in cancer immunotherapy to more tumor types, and supporting enhanced data sharing to speed discovery and verify treatment response. This funding would follow $195 million provided to NIH in FY 2016 to launch Moonshot activities immediately.

Precision Medicine
The budget request would provide $230 million for the Precision Medicine Initiative Cohort Program through the Common Fund, a $100 million (77 percent) increase above FY 2016. The cohort program aims to enroll more than 1 million volunteers to broaden understanding of precision medicine approaches that take into account individual variability in genes, environment, and lifestyle. This significant increase for the cohort program would enable implementation of the infrastructure needed to support initial enrollees.

The budget request would also provide $70 million for the Precision Medicine Initiative for Oncology (PMI-O) program at NCI, the same level as FY 2016. The primary element of this program is expanding clinical trials that select drug therapies based on the patient's molecular abnormalities rather than the site of the tumor's origin. The additional funding would help expand the NCI Molecular Analysis for Therapy Choice (NCI-MATCH) trial launched in 2015 and a similar trial, Pediatric MATCH, to be launched next year that would test the approach in children. NCI also plans to build an information platform for integrating data on genetics, tumor therapy response, and other data to identify new approaches for cancer therapeutics and care.

BRAIN Initiative
The budget request would provide a $45 million increase in mandatory funding for the NIH BRAIN Initiative, for a total of $195 million in FY 2017. Launched in 2013, the multi-agency initiative aims to develop new technologies to produce a clearer picture of the brain. The additional funding would support the ambitious goals of this initiative by funding basic neuroscience research, human neuroscience, neuroimaging, and training, as well as collaborative projects with industry to test new devices in the brain and to address big data collected from brain research.

Sources: HHS Budget in Brief, pages 47-51: http://www.hhs.gov/sites/default/files/fy2017-budget-in-brief.pdf; NIH FY 2017 budget overview: https://officeofbudget.od.nih.gov/pdfs/FY17/31-Overview.pdf; NIGMS FY 2017 congressional budget justification: https://publications.nigms.nih.gov/cjs/2017/cj2017.pdf; NCI FY 2017 congressional budget justification: http://www.cancer.gov/about-nci/budget/congressional-justification/fy2017-nci-congressional-justification.pdf; NIBIB FY 2017 congressional budget justification: http://www.nibib.nih.gov/sites/default/files/NIBIB_FY17CJ_FINAL_508.pdf; Common Fund FY 2017 congressional budget justification: https://officeofbudget.od.nih.gov/pdfs/FY17/1-Common%20Fund.pdf.

National Institutes of Health

(In thousands)

	FY 2015 Enacted	FY 2016 Enacted	FY 2017 Request	Request vs. FY 2016
NIH total	**30,311,349**	**32,311,349**	**33,136,349**	**825,000 (2.6%)**
National Cancer Institute (NCI)	4,953,028	5,213,509	5,893,509	680,000* (13.0%)
National Institute of General Medical Sciences (NIGMS)	2,372,301	2,512,437	2,512,437	--
Institutional Development Award (IDeA)	273,325	320,840	320,840	--
Biomedical Technology, Bioinformatics, and Computational Biology (BBCB)	230,059	240,043	239,983	-60 (0.02%)
National Institute of Biomedical Imaging and Bioengineering (NIBIB)	327,243	342,506	342,506	--
Discovery Science and Technology (DST)	95,891	106,468	103,418	-3,050 (2.9%)
National Institute of Dental and Craniofacial Research (NIDCR)	397,700	413,396	413,396	--
National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK)	1,899,140	1,966,310	1,966,310	--
National Institute of Neurological Disorders and Stroke (NINDS)	1,604,607	1,695,180	1,695,180	--
National Institute of Allergy and Infectious Diseases (NIAID)	4,417,558	4,715,697	4,715,697	--
Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD)	1,286,869	1,338,348	1,338,348	--
National Eye Institute (NEI)	676,764	707,998	707,998	--
National Institute of Environmental Health Sciences (NIEHS)	744,682	770,882	770,882	--
National Institute on Aging (NIA)	1,197,523	1,598,246	1,598,246	--
National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)	521,528	541,662	541,662	--

National Institute on Deafness and Other Communications Disorders (NIDCD)	405,207	442,936	442,936	--
National Institute of Mental Health (NIMH)	1,433,651	1,518,673	1,518,673	--
National Institute on Drug Abuse (NIDA)	1,015,705	1,050,550	1,050,550	--
National Institute on Alcohol Abuse and Alcoholism (NIAAA)	447,153	467,445	467,445	--
National Institute of Nursing Research (NINR)	140,852	145,912	145,912	--
National Human Genome Research Institute (NHGRI)	498,677	513,227	513,227	--
National Institute on Minority Health and Health Disparities (NIMHD)	270,969	280,680	280,680	--
National Center for Complementary and Integrative Health (NCCIH)	124,062	129,941	129,941	--
National Center for Advancing Translational Sciences (NCATS)	632,710	685,417	685,417	--
Cures Acceleration Network (CAN)	9,834	25,835	25,835	--
John E. Fogarty International Center (FIC)	67,634	70,117	70,117	--
National Library of Medicine (NLM)	337,324	395,684	395,684	--
Office of the Director (OD)	1,413,734	1,571,200	1,716,200	145,000 (9.2%)
Common Fund	545,639	675,639	775,639†	100,000 (14.8%)
Building and Facilities	128,863	128,863	128,863	--

*This increase is supported by mandatory funding.

†This amount includes mandatory funding for the Precision Medicine Initiative Cohort Program.

Interagency Initiatives and Priorities

National Strategic Computing Initiative

In July 2015, the Administration released the National Strategic Computing Initiative (NSCI), a government-wide effort aimed at developing a cohesive, multi-agency strategy for federal investment in high-performance computing (HPC). The initiative has five strategic themes:

- Create systems that can apply exaflops of computing power to exabytes of data – to combine the strengths of computers focused on simulation and complex modeling and computers focused on managing large amounts of data and create new capabilities with combinations of modeling, simulation, and data analytics.
- Keep the United States at the forefront of HPC capabilities – primarily through the Department of Energy pursuing exascale computing
- Improve HPC application developer productivity – by making systems easier to program, removing a major barrier to widespread use
- Make HPC readily available – through deployment of computing systems and education for researchers in the public and private sectors
- Establish hardware technology for future HPC systems – through fundamental research on potential successors to current semiconductor technology.

The Administration's request for FY 2017 builds upon this initial effort by proposing substantial investments in HPC through multiple agencies. DOE and NSF would receive the largest investments at $285 million and $33 million, respectively, and the Networking and Information Technology Research and Development (NITRD) program would continue to serve as the central planner and coordinator of government-wide HPC research.

In addition to DOE and NSF investments, which are detailed above, the **National Institute of Standards and Technology (NIST)** would also contribute to NSCI through an increased emphasis on science for future computing technologies. In particular, the President's FY 2017 request would more than double (increasing from $12 million to $25.6 million in FY 2017) the investment NIST is making in this area. The new effort recognizes not only new types of computing hardware, such as quantum computing, but also the need to develop specialized algorithms and software. NIST would leverage the increased funding to:

- "Develop atomic scale metrology";
    - "This includes research into fundamental measurement science to support those technologies, such as imaging techniques that can see single atoms and measurements so fast that they can watch a single computer switch as it switches."
- "Develop, test, prototype, and benchmark potential types of logic, memory, and storage device concepts that are likely to become more highly integrated in order to address the memory and storage requirements in an 'exascale' machine";
- "Develop standard frameworks for uncertainty quantification in scientific computing"; and
- "Establish a calibration framework for modeling and simulation." [3]

[3] http://www.osec.doc.gov/bmi/budget/FY17CBJ/NIST%20FY%202017%20CBJ%20508.pdf, NIST FY 2017 Congressional Budget Justification, National Institute of Standards and Technology, 2017 (pg. 35-36).

In addition to focusing on the opportunities that big data can provide for scientific research and development, the FY 2017 request also continues the federal government's focus on securing private data and the need to protect U.S. systems from cyberattack. Specific ways to address these challenges are outlined in the 2016 Federal Cybersecurity Research and Development Strategic Plan, which was released concurrently with the budget.[4]

Sources: https://www.whitehouse.gov/the-press-office/2015/07/29/executive-order-creating-national-strategic-computing-initiative; the NIST FY 2017 congressional budget justification: http://www.osec.doc.gov/bmi/budget/FY17CBJ/NIST%20FY%202017%20CBJ%20508.pdf; and https://www.whitehouse.gov/sites/default/files/microsites/ostp/nsci_fact_sheet.pdf

[4] https://www.whitehouse.gov/blog/2016/02/08/national-challenges-and-goals-cybersecurity-science-and-technology, National Challenges and Goals for Cybersecurity Science and Technology, The White House, 2016.